LTC3621
17V, 1A Monolithic Synchronous Step-Down Regulator

DESCRIPTION

Demonstration circuit 1863 is a step-down converter, capable of delivering up to 1A of output current from a minimum input voltage of 2.7V. The DC1863A uses the power-saving LTC®3621 1MHz monolithic synchronous buck regulator in a small 8-lead MS8 package. The LTC3621 IC quiescent currents can be as low as 3.5µA in normal operation, and less than 0.1µA in shut down. The output voltage range of the DC1863A is from as low as 0.6V, the reference voltage of the LTC3621, to as high as the maximum input voltage, 17V. The DC1863A can operate in three distinct operating modes: Burst Mode® operation for highest efficiency at low output currents, forced continuous mode for lowest output ripple voltage, and pulse-skipping mode for the best compromise operation between the two other modes, by setting the mode pin to $INTV_{CC}$ (3.6V), $INTV_{CC}/2$, or ground respectively. All these features make the DC1863A an ideal circuit for use in any high efficient, low power application.

Design files for this circuit board are available at http://www.linear.com/demo

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	VALUE
Input Voltage Range		2.7V to 17V
Output Voltage Range		0.6V to V_{IN}
Run/Shutdown	RUN Pin = GND	Shutdown
	RUN Pin = V_{IN}	Operating
Output Voltage Regulation	V_{IN} = 2.7V to 17V, I_{OUT} = 0A to 1A	1.2V ±3% Typ (1.164V to 1.236V)
	V_{IN} = 2.7V to 17V, I_{OUT} = 0A to 1A	1.8V ±3% Typ (1.746V to 1.854V)
	V_{IN} = 2.7V to 17V, I_{OUT} = 0A to 1A	2.5V ±3% Typ (2.425V to 2.575V)
	V_{IN} = 3.5V to 17V, I_{OUT} = 0A to 1A	3.3V ±3% Typ (3.201V to 3.399V)
	V_{IN} = 5.2V to 17V, I_{OUT} = 0A to 1A	5V ±3% Typ (4.85V to 5.15V)
Typical Output Ripple Voltage	V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 1A (20MHz BW)	<20mV_{P-P}
Nominal Switching Frequency		1MHz ± 8%
Operation Modes	MODE Pin = $INTV_{CC}$	Burst Mode
	MODE Pin = GND	Pulse-Skipping
	MODE Pin = $INTV_{CC}/2$	Forced Continuous
Burst Mode-to-CCM Operation	V_{IN} = 12V, V_{OUT} = 1.2V	I_{OUT} < 500mA
$INTV_{CC}$		3.6V ±8.33% (3.3V to 3.9V)

Table 2. Jumper Description

JUMPER	FUNCTION/RANGE	SETTING
JP1	Run: ON–OFF.	ON
JP2	Mode: Burst Mode Operation (BM) or Pulse-Skipping Mode (PS).	BM
JP3	Output Voltage Setting	1.2V

QUICK START PROCEDURE

Demonstration Circuit 1863 is easy to set up to evaluate the performance of the LTC3621. For proper measurement equipment configuration, set up the circuit according to the diagram in Figure 1. Before proceeding to test, check that the shunts are inserted into the correct locations: 1.2V position of the output voltage header JP3, into the BM (Burst Mode operation) position of MODE header JP2, and into the ON position of RUN header JP1.

When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the VIN or VOUT and GND terminals. See Figure 2 for proper scope probe measurement technique.

With the DC1863 set up according to the proper measurement configuration and equipment in Figure 1, apply 5V at VIN (Do not hot-plug VIN or increase VIN over the rated maximum supply voltage of 17V, or the part may be damaged.). Measure VOUT; it should read 1.2V (If desired, the quiescent current of the circuit can be monitored now by swapping the shunt in header JP1 into the OFF position). The output voltage should be regulating. Draw 500mA out of the output and measure VOUT—it should measure 1.2V ±2% (1.176V to 1.224V). Verify the switching frequency is between 920kHz and 1.08MHz (T = 1.08µs and 926ns), and that the switch node waveform is rectangular in shape.

Vary the input voltage from 2.7V to 17V and the load current from 0 to 1A. VOUT should regulate around 1.2V ±3% (1.164V to 1.236V). Measure the output ripple voltage; it should measure less than 20mV AC.

Set the input voltage to 12V and the output current to than 100mA. Observe the Burst Mode operation at the switch node (the pad of the inductor opposite from the output), and measure the output ripple voltage. It should measure less than 100mV. Change the shunt position on the MODE header from BM to PS (pulse-skipping mode) and observe the voltage waveform at the switch pins. To achieve forced continuous operation, insert two 100k resistors at the pads for R1 and R2. These resistors develop a voltage of $INTV_{CC}/2$ at the mode pin, which is the voltage setting for forced continuous operation.

Insert the JP1 shunt into the OFF position and move the shunt in the 1.2V output JP3 header into any of the remaining output voltage option headers: 1.8V (JP4), 2.5V (JP5), 3.3V (JP6) or 5V (JP7). Just as in the 1.2V VOUT test, the output voltage should read V_{OUT} ±2% tolerance under static line and load conditions and ±1% tolerance under dynamic line and load conditions (±3% total). Also, the circuit switch operation in Burst or pulse-skipping mode will remain the same. There is an extra output voltage header, JP8, to allow the user to easily set the output to their desired value

When finished, turn off the circuit by inserting the shunt in header JP1 into the OFF position.

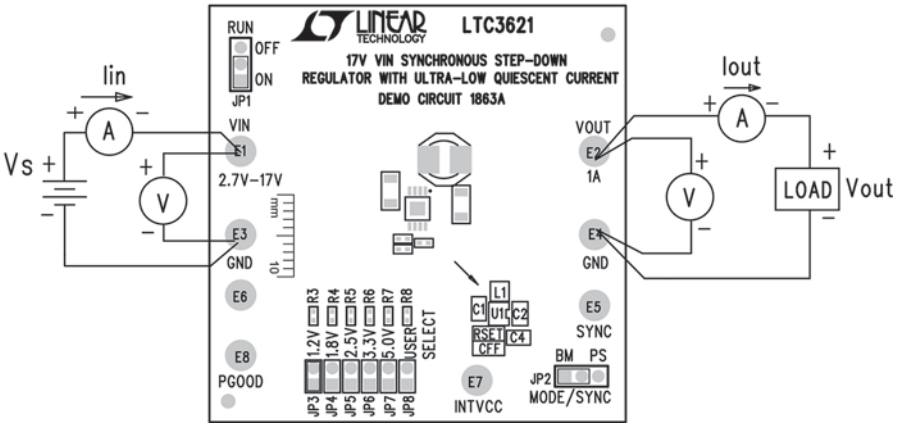


Figure 1. Proper Equipment Measurement Setup

QUICK START PROCEDURE

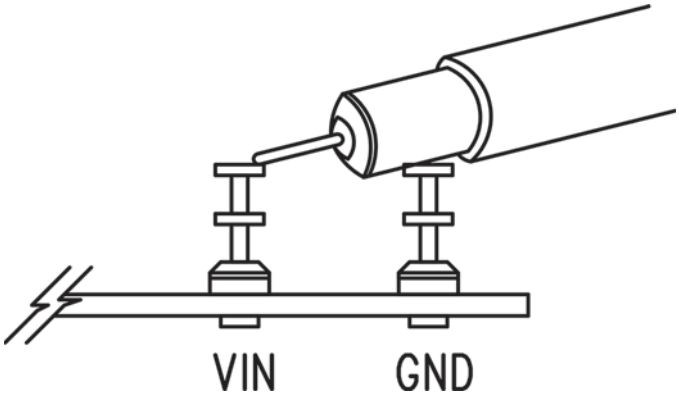
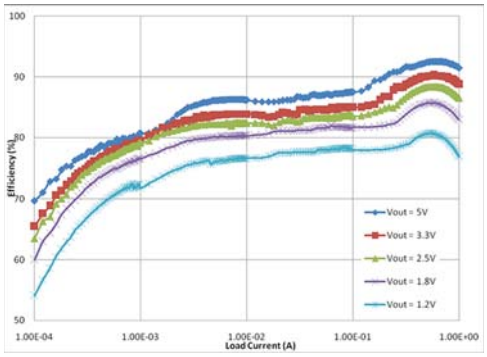


Figure 2. Measuring Input or Output Ripple

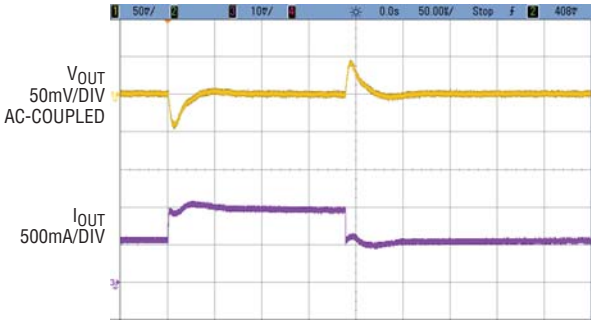
EFFICIENCY DATA



V_{IN} = 12V
Burst Mode OPERATION
f_{SW} = 1MHZ
L = 4.7µH COILCRAFT XFL-4020

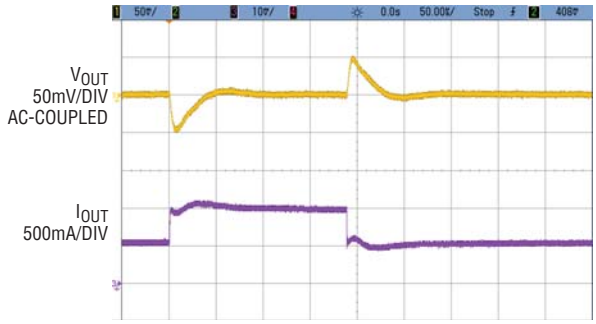
Figure 3. Efficiency vs Load Current

LOAD STEP RESPONSE WAVEFORMS



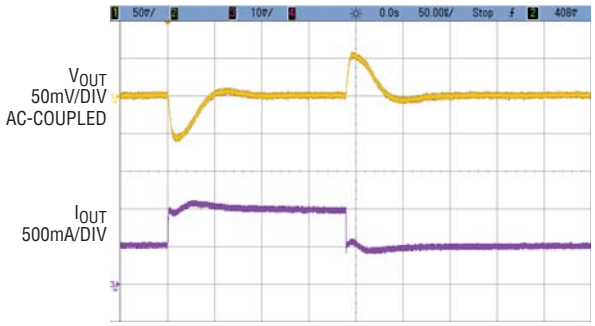
V_{IN} = 12V 50µs/DIV
V_{OUT} = 1.2V
500mA LOAD STEP (500mA TO 1A)
PULSE-SKIPPING MODE
f_{SW} = 1MHz

Figure 4



V_{IN} = 12V 50µs/DIV
V_{OUT} = 1.8V
500mA LOAD STEP (500mA TO 1A)
PULSE-SKIPPING MODE
f_{SW} = 1MHz

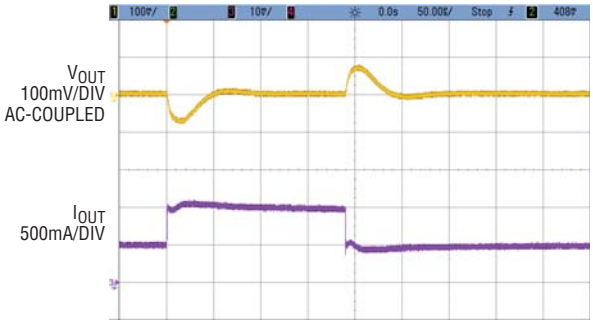
Figure 5



V_{IN} = 12V 50µs/DIV
V_{OUT} = 2.5V
500mA LOAD STEP (500mA TO 1A)
PULSE-SKIPPING MODE
f_{SW} = 1MHz

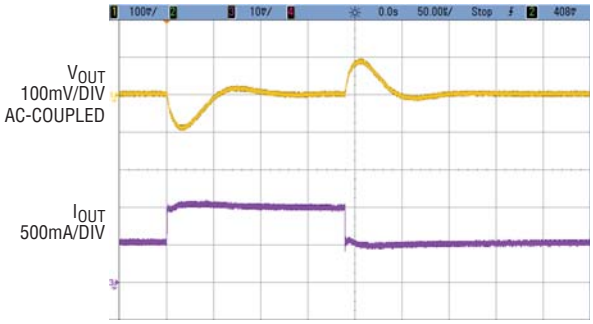
Figure 6

LOAD STEP RESPONSE WAVEFORMS



V_{IN} = 12V 50µs/DIV
V_{OUT} = 3.3V
500mA LOAD STEP (500mA TO 1A)
PULSE-SKIPPING MODE
f_{SW} = 1MHz

Figure 7



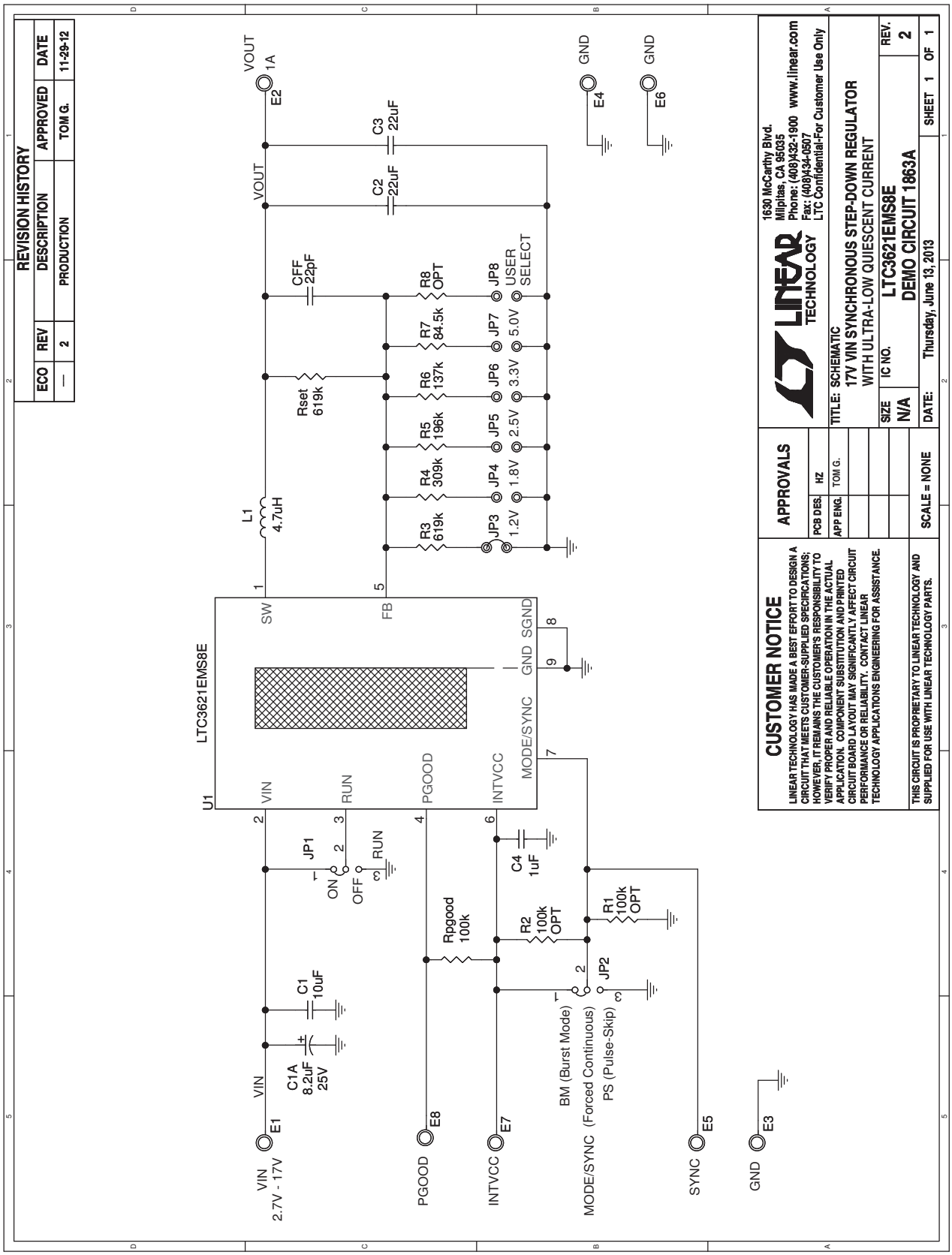
V_{IN} = 12V 50µs/DIV
V_{OUT} = 5V
500mA LOAD STEP (500mA TO 1A)
PULSE-SKIPPING MODE
f_{SW} = 1MHz

Figure 8

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CFF	CAP., X7R, 22pF, 50V, 0402	AVX 04025A220KAT
2	1	C1	CAP., X5R, 10µF, 25V, 10%, 1206	AVX 12063D106KAT
3	2	C2, C3	CAP., X5R, 22µF, 25V, 10%, 1206	AVX 12063D226KAT
4	1	C4	CAP., X5R, 1µF, 6.3V,20%, 0402	TDK, C1005X5R0J105M
5	1	L1	IND., FIXED INDUCTOR, 4.7µH	COILCRAFT XFL4020-472MEB
6	2	R3, Rset	RES., CHIP, 619k, 1%, 0402	VISHAY CRCW0402619KFKED
7	1	U1	LTC3621EMS8E, MS8 PACKAGE, 8-LEAD, MSOP	LINEAR TECH. LTC3621EMS8E#PBF
Additional Demo Board Circuit Components				
1	1	C1A	CAP., X5R, 8.2µF 20V, SIZE B2, 3528-7343	SANYO 20TQC8R2M
2	0	R1, R2 OPT	RES., CHIP, 0402	
3	1	Rpgood	RES., CHIP, 100k, 1%, 0402	VISHAY CRCW0402100K0FKED
4	1	R4	RES., CHIP, 309k, 1%, 0402	VISHAY CRCW0402309KFKED
5	1	R5	RES., CHIP, 196k, 1%, 0402	VISHAY CRCW0402196KFKED
6	1	R6	RES., CHIP, 137k, 1%, 0402	VISHAY CRCW0402137KFKED
7	1	R7	RES., CHIP, 84.5k, 1%, 0402	VISHAY CRCW040284K5FKED
8	0	R8 OPT	RES., CHIP, 0402	
Hardware				
1	8	E1-E8	TESTPOINT, TURRET, 0.095"	MILL-MAX 2501-2-00-80-00-00-07-0
2	2	JP1, JP2	2MM SINGLE ROW HEADER, 3-PIN	SULLINS NRPN031PAEN-RC
3	6	JP3-JP8	2MM SINGLE ROW HEADER, 2-PIN	SULLINS NRPN021PAEN-RC
4	3	JP1-JP3	SHUNT	SAMTEC 2SN-BK-G

SCHEMATIC DIAGRAM



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